REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN

Chemical Recovery Systems, Inc.
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Elyria, OH 44035
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Revision II
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Prepared for:

CRS Site Group

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FIELD SAMPLING PLAN

FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT CHEMICAL RECOVERY SYSTEMS, INC. ELYRIA, OHIO

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1.0 FIELD SAMPLING PLAN

1.1 INTRODUCTION

This Field Sampling Plan (FSP) provides detailed guidance for the sampling and data gathering methods to be used for the Remedial Investigation (RI) at Chemical Recovery Systems, Inc. (CRS), Elyria, Ohio (Figure 1-1). Sampling activities conducted at the CRS site will help to obtain information, which will be used to fill in data gaps from previous site investigations (Table 1-1)[1].

The activities discussed in this Field Sampling Plan (FSP) are related only to the RI activities. Sampling locations and analyses to be completed during this assessment are also discussed in this plan. Rationale for each sample collection location and analysis are provided in Section 2.0 and summarized in Table 2-1. Methods that will be used to complete this assessment are described in Sections 3 and 4 and in Appendices A, B, and C.

1.2 FIELD OPERATION SITE OBJECTIVES

Several different actions will be completed as a part of the upcoming RI activities planned for the CRS site. These activities will include soil boring and monitoring well installation, soil sampling, surface soil sampling, groundwater sampling, and surface water and sediment sampling. Several areas of concern (AOCs) have been identified on the 2.5-acre subject property, and will be studied using these activities (Figure 1-2). Table 1-2 presents the AOCs to be investigated and the activities to be conducted in each area. The goals of this process include:

- the collection of data to characterize physical and chemical conditions at the site and to determine the nature, magnitude, and extent of chemicals of concern in affected media;
- identify of all source areas/areas of concern at the site and define the nature and extent of impact in these areas;
- identify and define sources (if any) of past or current discharges to the Black River;
- the assessment of risk-specific objectives related to human health and the environment;

[1] Nothing herein shall be deemed an admission of fact or law by any CRS Site Group Member.

- collect data for treatability studies and feasibilities studies (if needed); and,
- the evaluation of appropriate remedies.

1.3 FIELD ACTIVITIES

The planned field activities are described in this section. This description includes activities that will be performed on-site. The actual sampling locations, frequencies, analytical parameters, rationale, and procedures to complete the planned activities are described in Sections 2.0 and 3.0 of this document.

The purpose of the RI/FS is to investigate the nature and extent of impacted media for the CRS Site, to determine if the impacted media pose a threat to public health or the environment, and to develop and evaluate potential remedial alternatives. Activities to be conducted at the site and objectives of these activities are described below and are summarized in Table 1-2.

Soil Sampling/Monitoring Well Installation

- Install soil borings and sample surface and subsurface soils to evaluate the vertical and horizontal extent of chemicals of concern in the site soil near suspected areas of concern;
- Sample surface soils to evaluate possible direct exposure pathways;
- Install shallow monitoring wells to evaluate shallow aquifer conditions;
- Install deep monitoring wells to evaluate deep aquifer conditions;

Surface Water and Sediment Sampling (The Black River)

- Collect surface water and sediment samples to evaluate potential chemicals of concern that may have migrated to the Black River, and to evaluate possible direct exposure pathways.
- Collect surface soil samples along the top of the riverbank of the Black River, where possible.

Groundwater Sampling

- Sample groundwater in new and existing monitoring wells to provide information on site hydrology and possible groundwater impact (horizontally and vertically).

Table 1-1
Data Gap Identification
CRS Site
Elyria, Ohio

AOC	Previous Assessments	Identified Data Gap
Drum Storage Areas (4 total)	Soil samples collected in 1981 and 1996 indicated that several former drum storage areas were impacted (at varying depths) with VOCs, SVOCs, PCBs and metals. No information has been collected on the groundwater quality in the drum storage areas.	Data gaps exist with respect to current condition of soils in areas where surficial soils were excavated and in areas where no soil sampling was completed. The horizontal and vertical extent of impacted soil is unknown in the drums storage areas. In addition, the groundwater quality (vertical and horizontal extent) in these areas is unknown.
Tanker Staging Areas (2 total)	No soil or groundwater information has been collected in the tanker storage areas.	Current soil quality and extent of impact (horizontally and vertically) of these areas is unknown. In addition, the groundwater quality (vertical and horizontal extent) in these areas is unknown.
Former Brighton Still Building and Aboveground Storage Tank (AST) Tank Farm	Soil samples were collected within the former Brighton Still Building. Sampling indicated the presence of VOCs, SVOCs, PCBS, and metals in the soil sample analyzed. Monitoring well, MW-1, was installed adjacent to the Brighton Still Building. Results of groundwater samples collected from MW-1 indicate the presence of VOCs, SVOCs, PCBs, and metals. Remedial activities were conducted with the removal of soil to the depth of one-foot bsg around the perimeter of the Brighton Still Building. No soil and groundwater samples have been collected in the area of the former AST tank farm.	The magnitude and extent (horizontal and vertical) of impacted soil has not been defined in this area. The extent (horizontal and vertical) of groundwater impact is unknown.
Rodney Hunt Still Building	Soil samples collected from vicinity of the Rodney Hunt Still Building. Samples, analyzed for VOCs, SVOCs, metals and pesticides / PCBs, indicated the presence of metals in this area. No soil samples have been collected from the destroyed portion of the building. Monitoring well MW-3 was installed to the south of the building. Groundwater samples collected from MW-3 indicated the presence of metals.	The presence and extent of possible soil impacts in the area of the Rodney Hunt Still Building is unknown. The vertical and horizontal extent of groundwater impact (if any) is unknown.
Storm Sewer Outfall (The Black River)	The 1981 sampling indicated presence of VOCs and metals downgradient of the storm sewer outfall pipe concentrations in excess of upgradient sampling points. No samples have been collected along the storm sewer to determine if the soil has been impacted. In addition, no samples have been collected along the riverbank of the Black River.	Current surface water and sediment quality has not been defined. The presence and extent of impacted soil along the storm sewer is unknown. The presence and extent of impacted surface soil on the bank of the Black River is unknown. In addition, the integrity of the storm sewer is unknown.

Table 1-2
Site Activity List
CRS Site
Elyria, Ohio

AOC	Activities to be Performed	Media to be Analyzed
Drum Storage Areas (4 total)	Soil Borings, Soil Sampling, Monitoring Well Installation (permanent and temporary), and Groundwater Sampling	Soil and Groundwater
Tanker Staging Areas (2 total)	Soil Borings, Soil Sampling, Monitoring Well Installation (permanent and temporary), and Groundwater Sampling	Soil and Groundwater
Former Brighton Still Building and AST Tank Farm	Soil Borings, Soil Sampling, Monitoring Well Installation (permanent and temporary), and Groundwater Sampling	Soil and Groundwater
Rodney Hunt Still Building	Soil Borings, Soil Sampling, Monitoring Well Installation (permanent and temporary), and Groundwater Sampling	Soil and Groundwater
Storm Sewer Outfall (The Black River)	Soil Borings, Soil Sampling (along storm sewer line), TV Inspection of Storm Sewer, Surface Water and Sediment Sampling, Surface Soil Sampling along the top of the riverbank	Soil, Surface Soil, Surface Water, and Sediment

- Existing Monitoring Well MW-2 will be sampled to determine water quality in and around Former Tanker Staging Area 1.
- Two additional groundwater monitoring wells (L-2 and L-3), which have been installed by Engelhard Corporation along Locust Street, will be sampled.

2.0 RATIONALE FOR SAMPLING PLACEMENT AND COLLECTION

2.1 SAMPLING PROGRAM

Based on the above data gaps and data quality objectives (DQOs), a sampling plan has been developed to obtain information on the presence, extent, and magnitude of chemicals of concern (COCs) in the site's soil, groundwater, surface water, and sediment. Sampling activities will target areas of concern, as outlined in Table 1-2. The sampling activities have been developed to define the extent of impact (both horizontally and vertically) in the site soil and groundwater, which will satisfy the data needs of the site.

Based on USEPA guidance, information on the contaminant source(s) and environmental setting should be determined, prior to developing a sampling program. Useful data may be found in the following sources, when available: facility assessment reports, facility records and files, regulatory agencies, design and construction diagrams, permits, environmental studies, interviews with facility personnel, environmental audit reports, environmental insurance policies, etc. (USEPA, 1989).

A review of data from a variety of sources has revealed that a substantial amount of information is available regarding historic site operations, including aerial photographs from 1966 and 1978, during solvent recovery operations at the site. Data regarding areas of likely impact are also available from the investigation and remedial actions, performed in the early 1980s, and the state and federal site assessments conducted in the mid 1990s (see Section 2.7 of the Work Plan). This information has been used to identify areas of concern for targeted sampling to maximize the efficiency of the RI. Areas of concern have been divided into five categories: Former Drum Storage Areas, Former Tanker Storage Areas, the Former Brighton Still Building and AST area, the Rodney Hunt Still Building, and the Storm Sewer Outfall (The Black River) (Figure 1-2).

Targeting known areas of impact (judgmental sampling) is appropriate, under USEPA guidance, when specific information exists on the potential configuration of a release or areas of impact (USEPA, 1989). Many releases are likely to fall into this category, because the site layout or characteristics will often indicate areas of potential impact. Judgmental sampling will

generally bias the data toward higher contaminant concentrations. In many cases, this approach will suit the needs of the remedial field investigation (USEPA, 1989).

During the RI, five soil borings will be installed in each area of concern. Borings will be placed to the north, south, east, west, and in the center of each area of concern to determine the horizontal extent of impacted soil (Figure 2-1). The boring, advanced in the center of each AOC, will be completed as a one-inch temporary monitoring well. In addition to the one-inch temporary monitoring wells, eight two-inch permanent wells will be installed at the site. Three permanent wells will be deep (40 to 50 feet bsg) and five will be shallow (15 to 25 feet bsg) in depth to determine the vertical extent of groundwater impact. A total of 19 groundwater samples will be collected at the site (8 temporary monitoring wells, 8 permanent monitoring wells, MW-2, and L-2 and L-3 (located across Locust Street). Five surface water and sediment samples will be collected upgradient and adjacent to the site property (Figure 2-1). In addition, 4 geotechnical soil samples will be collected at the site to determine the sand size and screen slot size during monitoring well construction. Geotechnical samples will also be utilized in site characterization. The location of the geotechnical samples will be determined, based on the soil types encountered in the soil borings.

Sampling activities will occur in three phases at the site. The first phase will include the installation of 39 soil borings (including temporary monitoring wells), using a Geoprobe™ drill rig. During this time, soil samples will be collected from all soil borings and submitted for laboratory analysis. Groundwater samples will also be collected from the temporary monitoring wells and submitted for laboratory analysis. After all soil borings are completed, four geotechnical soil samples (two in fill material and two in natural soil) will be collected. The locations of the geotechnical samples will be based on field observations during soil borings installation. All soil borings will be backfilled with bentonite holeplug, after all soil samples are collected. The temporary monitoring wells will be completed with a temporary well pad and will be capped. These wells will be utilized as "piezometers" to aid in the installation of the permanent monitoring wells; however, the temporary monitoring wells will be sampled only once during the first phase of sampling. During this time, five surface soil samples will also be collected from the top of the bank of the Black River. Due to the steep grade and the thin

veneer of material along the bank of the Black River adjacent to the site, the soil samples will be collected from five accessible locations along the top of the riverbank to be identified in the field.

After receipt of preliminary sample results from the first phase of sampling, the second phase of sampling will occur at the site. The second phase of sampling will include the installation of the eight two-inch permanent wells, soil sampling, groundwater sampling (of the newly installed permanent wells, and existing wells (MW-2, L-2, and L-3)), sediment and surface water sampling. The location of the permanent monitoring wells may be adjusted, based on the results of the first phase of sampling (soil and groundwater samples). At this time, the sediment and surface water samples will be collected and submitted for laboratory analysis. If it is determined that PCBs are present in the site soil and / or groundwater, surface water and sediment samples may be analyzed for PCBs. If, at the time of sampling, there are fluids discharging from any of the conduits along the riverbank, a surface water and sediment samples will be collected from the conduit. The temporary monitoring wells will be utilized for water level measurements, but will not be sampled during the second phase of field activities. After all sampling activities are completed, the temporary monitoring wells will be removed and backfilled with bentonite, prior to the completion of field activities.

After the final data from the first and second phases of sampling is received from the laboratory, it will be validated and evaluated. Based on the results of the field sampling, additional data may be collected to determine extent (if needed), to aid in feasibility studies (if needed), and/or to characterize investigative derived wastes (IDW) (if needed).

During all phases of field activities, an effort will be made to locate monitoring wells MW-1, MW-2, and MW-3. If any of these monitoring wells are located, the wells will be properly abandoned to eliminate potential conduits from the surface to groundwater.

All samples will be located in the field using an aerial photograph with a known scale and existing site structures. All sampling locations will be marked with a surveyors stake marked with the sampling location numbers, and professionally surveyed.

2.2 FORMER DRUM STORAGE AREAS

Based on aerial photographs and other historical information, four former drum storage areas have been identified on the CRS site (Figure 2-1). These areas are most likely impacted from site operations. Past sampling events conducted in these areas indicate the presence of VOCs, SVOCs, and metals (Table 2-1). Sampling will be conducted in order to confirm if the media in these areas are indeed impacted, and to further define soil quality.

Five soil borings will be advanced in and around each of the four former drum storage areas, using direct-push technologies (e.g., Geoprobe^{TM}) to determine the horizontal and vertical extent of impacted soils in the area. Borings will be advanced to the north, south, east, west, and in the center of each former drums storage area (Figure 2-1). The soil boring installed in the center of each former drum storage area will be completed as a one-inch temporary monitoring well. In addition to the temporary monitoring wells, permanent two-inch will be installed downgradient of the former drum storage areas, where space allows. A set of two monitoring wells (one shallow and one deep) will be installed downgradient of former Drum Storage Area 2 and a deep monitoring well will be advanced downgradient of former Drum Storage Area 3 (Figure 2-1). The shallow well will be installed to monitor the uppermost-saturated zone at the site, near potential source areas. The two deeper bedrock wells will be installed to evaluate the vertical extent of impacted groundwater at the site.

2.3 FORMER TANKER STORAGE AREAS

Based on information gathered from aerial photographs, a total of two former tanker staging areas have been located at the CRS site. Soil borings conducted in these staging areas in 1981 detected concentrations of VOCs and SVOCs. Results of previous groundwater data collected at the site indicated that monitoring well MW-2 was impacted by VOCs, SVOCs, and PCBs (Table 2, Appendix A of the Work Plan). Five soil borings will be advanced in and around each of the four tanker storage areas, using direct-push technologies (e.g. Geoprobe^{TM}) to determine the horizontal and vertical extent of impacted soils in the area. Borings will be advanced to the north, south, east, west, and in the center of each former tanker storage area (Figure 2-1). The soil boring installed in the center of each former tanker storage area will be completed as a one-inch temporary monitoring well. In addition to the temporary monitoring

wells the existing monitoring well MW-2 (down gradient of former tanker staging area 1) will be sampled to determine if groundwater in the upper saturated zone is impacted due to historic site operations. A deep monitoring well will also be installed downgradient of the Former Tanker Storage Area 2. This well will be utilized to evaluate the vertical extent of impacted groundwater at the site.

2.4 THE FORMER STILL BUILDINGS

The concrete slab foundation of the Brighton Still building and the secondary containment dike for the former AST farm remain in the northwestern corner of the site, although all tanks have been removed. A portion of the Rodney Hunt Building is still intact on the southeastern portion of the CRS site. A large portion of the Rodney Hunt Still Building was destroyed by fire at an earlier date (Figure 2-1). One sump is located in the Rodney Hunt Building. Another sump was historically located in the former Brighton Still Building, but was not visible during a site visit due to the dense vegetation. Past soil borings collected near the former Brighton Still building indicated presence of VOCs, SVOCs, and PCBs. Groundwater samples collected from MW-1 (located adjacent to the Former Brighten Still Building) during the 1981 Field Investigation Team (FIT) investigation indicated that the groundwater was impacted with VOCs, PCBs and metals. During the 1996 Site Team Evaluation Prioritization (STEP) investigation, groundwater samples indicated the presence of VOCs to a lesser extent than the 1981 investigation. A soil sample (B-9) collected near the Rodney Hunt building during the FIT investigation indicated the presence of metals (Table 1 Appendix A of the Work Plan). In addition, monitoring well MW-3 (located adjacent to the Rodney Hunt Still Building), which was sampled during the FIT investigation indicated the presence of metals (Table 2, Appendix A of the Work Plan).

Five soil borings will be advanced in and around each of the still building areas, using direct-push technologies (e.g. Geoprobe^{TM}) to determine the horizontal and vertical extent of impacted soils in the area. Borings will be advanced to the north, south, east, west, and in the center of each still building (Figure 2-1). The soil boring installed in the center of each still building will be completed as a one-inch temporary monitoring well. In addition, a shallow monitoring well will be installed downgradient of both the Brighten Still Building and the

Rodney Hunt Still Building to determine if the shallow groundwater in the area has been impacted by former site activities. A deep monitoring well will be installed upgradient of the Former Aboveground Storage Tank Area to evaluate the vertical extent of COCs in the site groundwater.

2.5 THE STORM SEWER OUTFALL (THE BLACK RIVER)

Four soil borings will be installed adjacent to the storm sewer line to evaluate the soil quality adjacent to the pipe. In addition, a tv camera inspection of the storm sewer will be completed to determine the integrity of the line. To determine the surface water or sediment quality, four surface water and samples will be collected equidistant along the bank of the Black River adjacent to and upgradient of the site. A surface water and sediment sample will also be collected directly from the storm sewer outfall. Surface water and sediment samples will be collected at identical locations. Surface water samples will be collected prior to the sediment samples. In addition, the farthest downstream sample will be collected first, working to the farthest upstream sample to minimize suspended sediments from upstream impacting the downstream samples. If, at the time of sampling, there are fluids discharging from any of the conduits along the riverbank, surface water and sediment samples will be collected from the conduit. In addition, five surface soil samples will be collected along the top of the riverbank of the Black River. The location of surface soil samples will be determined in the field, where access permits.

2.6 LABORATORY ANALYSIS

All soil samples submitted to the laboratory will be analyzed for VOCs, SVOCs, PCBs, and metals by SW 846 Methods. Groundwater samples collected from all temporary and permanent monitoring wells (16 total), MW-2, and L-2 and L-3 (located across Locust Street) will be analyzed for VOCs, SVOCs, PCBs (filtered and unfiltered), and metals (filtered and unfiltered) by SW 846 Methods and monitored natural attenuation (MNA) parameters. Surface water and sediment samples will be analyzed for VOCs, SVOCs, and metals, using SW 846 Methods (Table 2-2).

Table 2-1
Sampling Program Rationale
CRS Site
Elyria, Ohio

Media	Previous Assessments	Proposed Sampling Activities/Depths	Proposed Analyses / (Samples)	Rationale
Soils	Soil samples collected at the site indicate the presence of VOCs, SVOCs, PCBs, and metals. In addition, remedial activities have been conducted at the site, which included soil removal. No samples have been collected along the riverbank.	Install and sample 39 soil borings to approximately 15 feet bsg, to the groundwater interface, or to the top of bedrock. Collect five soil samples from the top of the bank of the Black River.	VOCs SVOCs PCBs Metals	Define the extent (horizontally and vertically) of impact in all areas of concern at the site. Five soil borings will be installed in each AOC: the center, to the north, south, east and west. To determine if the bank of the Black River has been impacted by historic site activities.
Groundwater (shallow and deep)	Groundwater samples collected at the site indicate the presence of VOCs, SVOCs, PCBs, and metals.	Install 8 one-inch temporary wells and 8 two-inch permanent wells. Five shallow and three deep wells will be installed at the site. Collect groundwater samples from 19 locations (the 16 newly installed wells; MW-2, and L-2 and L-3, located across Locust Street).	VOCs SVOCs PCBs Metals	Define the extent (horizontal and vertical) of groundwater impact from former site activities.
Surface Water and Sediment	Surface water and sediment samples collected adjacent to and upgradient of the site indicate the presence of VOCs and metals.	Collect five surface water and sediment samples from locations, including one directly from the storm sewer outfall pipe, shown on Figure 5-1.	VOCs SVOCs Metals	To determine surface water and sediment quality.

- A maximum of three soil samples will be submitted for laboratory analysis from soil borings (including those to be completed as one-inch temporary monitoring wells): the sample with the highest PID reading from 0 to 3 feet bsg; the sample from the depth interval just above the groundwater interface; and the sample from the depth interval with highest PID reading above the groundwater interface. If the sample with the highest PID reading above the groundwater interface is also the sample from just above the water table, only two soil samples from that boring will be submitted for laboratory analysis.
- A maximum of two soil samples will be submitted for laboratory analysis from soil borings to be completed as two-inch permanent monitoring wells: the sample from the depth interval just above the groundwater interface; and the sample from the depth interval with highest PID reading above the groundwater interface. If the sample with the highest PID reading above the groundwater interface is also the sample from just above the water table, only one soil sample from that monitoring well will be submitted for laboratory analysis.
- Shallow monitoring wells will be installed to a depth of 15 to 25 feet bgs. Deep monitoring wells will be installed to a depth of 40 to 50 feet bgs.
- All monitoring well locations will also be analyzed for MNA parameters, which includes chloride (laboratory), ferrous iron (Hach kit), nitrate (Hach kit), sulfate (Hach kit); dissolved oxygen (field equipment), PID (field equipment), temperature, pH, conductivity (field equipment), ORP (field equipment), methane, ethene, ethane (laboratory).
- All sampling locations are shown on Figure 2-1.

Table 2-2 (Continued)
Analytical Methods and Total Number of Analyses
CRS Site
Elyria, Ohio

Parameter	Matrix	Analytical Method	Number of Analyses	Trip Blanks	Equipment Blanks	Duplicates	MS/ MSD	Total Analyses
Sediment Samples								
VOCs	Sediment	8260	5	1	--	1	--	7
SVOCs	Sediment	8270	5	--	--	1	--	6
Metals	Sediment	6010/7470/ 7471	5	--	--	1	--	6
Surface Soil Samples along Riverbank								
VOCs	Soil	5035	5	1	1	--	--	7
SVOCs	Soil	8270	5	--	--	--	--	5
PCBs	Soil	6010/7470/ 7471	5	--	--	--	--	5
Metals	Soil	8081	5	--	--	--	--	5

- Thirty-nine soil boring (8 of which will be completed as one-inch temporary monitoring wells) will be advanced at the site. A maximum of three soil samples will be collected from these soil borings: a sample with the highest PID from 0 to 3 feet bsg; the sample from the depth interval above the groundwater interface; and the sample from the depth interval with the highest PID reading above the groundwater interface. If the sample with the highest PID reading is also the sample from the depth interval just above the groundwater interface, only two soil samples will be submitted for laboratory analysis.
- Eight soil borings to be completed, as two-inch permanent monitoring wells will be advanced at the site. A maximum of two soil samples will be collected from each of these soil borings: the sample from the depth interval above the groundwater interface and the sample from the depth interval with the highest PID reading above the groundwater interface. If the sample with the highest PID reading is also the sample from the depth interval just above the groundwater interface, only one soil sample will be submitted for laboratory analysis.
- A total of 19 groundwater samples will be collected from the site (8 temporary and 8 permanent monitoring wells, existing monitoring well MW-2, and existing wells L-2 and L-3 located across Locust Street. In addition to the proposed analytical parameters, field measurements of dissolved oxygen, oxidation-reduction potential, turbidity, pH, temperature, conductivity, nitrate, sulfate, and ferrous iron will be collected.
- Five surface water and sediment samples will be collected adjacent to and upgradient of the site, including one sample to be collected from the storm sewer outfall. The farthest downgradient sample will be collected first, working to the farthest upstream sample to minimize suspended sediments from upstream impacting the downstream samples. In addition, the surface water samples will be collected prior to the sediment samples.
- Geotechnical samples will be analyzed for Vertical Hydraulic Conductivity (ASTM-D5084), Bulk Density (D2937), Moisture Content (ASTM D2216), Grain Size (ASTM D422), Porosity, and Total Organic Carbon (415.1).

of concern to determine the extent of the impact. All borings will be abandoned upon collecting soil samples. Borings will be abandoned by filling the boring with bentonite holeplug.

Boring locations will be determined in the field using high-resolution aerial photographs with a known scale. Based on the aerial photograph, boring locations can be scaled off using permanent onsite structures (buildings, foundations, monitoring wells, railroad tracks, etc.). During the site investigation, a stake with the boring identification number will be placed at all boring locations (including temporary monitoring wells). After all field activities are completed, the boring locations, temporary monitoring wells, and permanent monitoring wells will be professionally surveyed.

Geotechnical samples will be collected (2 in natural soils and 2 in fill materials) after all soil borings have been completed to aid in the geotechnical sampling location placement. Geotechnical samples will be analyzed for grain size, moisture content, vertical hydraulic conductivity, bulk density, and porosity. Results will be utilized in determining the screen slot size and sand pack to be used in monitoring well construction. In addition, geotechnical information will be utilized in site characterization. All geotechnical soil sampling will be conducted following SOP 14 (Appendix A).

In addition, the surface soil samples collected along the top of the riverbank will be collected using a stainless steel hand trowel. Samples will be placed in appropriate laboratory containers immediately and placed on ice in a cooler. In areas where there is a sufficient amount of soil cover, a soil sample will be collected for field screening for VOCs using a PID. If there is not sufficient soil cover to collect a sample for field screening, no sample will be collected.

Soils will be classified with respect to type, grain size, mineralogy (when pertinent), color, etc. In order to provide a lithologic description in a consistent manner, a number of standards have been incorporated into a standard procedure for logging a soil boring. Field personnel will use the Unified Soil Classification System for soil classification and descriptions. Grain size determination will follow the Wentworth (1922) system as illustrated in Table 3-1. A description of sorting will employ the standards of Folk (1968) as illustrated on Figure 3-1. Moisture content will be documented in terms of dry, damp, moist, or saturated.

3.4.2 Monitoring Well Installation

During the second phase of sampling activities, eight two-inch permanent monitoring wells will be installed at the site, five of which will be shallow (15 to 25 feet bgs) and three will be deep (40 to 50 feet bgs) to define the horizontal extent and magnitude of chemicals of concern in site groundwater. The shallow wells will be installed to monitor the uppermost saturated zone at the site, near potential source areas. The three deeper bedrock wells will be installed to evaluate the vertical extent of impacted groundwater at the site. These data will augment the data collected from the eight temporary monitoring wells, which will be installed and sampled during the first phase of sampling. The locations of the permanent monitoring wells may be adjusted based on the preliminary results of the first phase of sampling activities. Soil borings, to be completed as permanent monitoring wells, will be advanced using a drill rig equipped with hollow stem augers. Soil samples will be collected continuously from the surface to the bottom of the boring in two-foot intervals. All samples will be field screened for VOCs, using a PID (Appendix A, SOP 12). A maximum of two grab soil samples will be submitted from each monitoring well location for laboratory analysis: the sample from the depth interval just above the groundwater interface and the subsurface sample with the highest PID reading above the groundwater interface. If the sample from the depth interval just above the groundwater interface is also the sample with the highest PID reading, only one soil sample from that boring will be submitted for laboratory analysis. Diagrams of typical shallow and deep monitoring well construction are shown in Figure 3-2 and 3-3. Monitoring well construction will follow the procedures outlined in SOP 5, and all soil samples will be collected as described in SOP 4, both in Appendix A.

An effort will be made to locate monitoring wells MW-1, MW-2, and MW-3 in the field. If any of these monitoring wells are located, the wells will be properly abandoned to eliminate potential conduits from the surface to groundwater.

Monitoring well sample locations will be placed in the field using aerial photographs. Following site investigation activities, monitoring wells will be professionally surveyed.

3.4.3 Monitoring Well Development

All new wells installed, as a part of this investigation, and existing wells will be properly developed following procedures outlined in SOP 6 (Appendix A).

3.4.4 Groundwater Level Measurements

Water level measurements will be taken in all wells to determine the elevation of the water table at least once within a single 24-hour period. The measurements will be taken after all wells have been installed and developed and their water levels have recovered completely. A water level indicator will be used to gauge depth to groundwater in monitoring wells on-site to a measured surveyed point on the top of the casing. Groundwater levels will be measured to the nearest 0.01-foot.

3.5 GROUNDWATER SAMPLING

Each newly installed permanent and temporary wells (16 total), along with the existing on-site well (MW-2) and two existing wells along Locust Street (previously installed by Engelhard Corporation), will be appropriately sampled for VOCs, SVOCs, PCBs, TAL metals, chloride, methane, ethane, and ethene (Table 2-2). Samples collected for PCB and metal analysis will be field filtered prior to sample collection. Unfiltered samples will also be collected and analyzed. All wells will be allowed one week after the completion of well installation activities to equilibrate, prior to sampling. MNA parameters (dissolved oxygen, pH, conductivity, temperature, oxidation-reduction potential (ORP), sulfate, nitrate, and ferrous iron) will also be collected at each monitoring well location to determine if natural attenuation processes are occurring on dissolved organic compounds present in on-site groundwater. These field parameters will be collected in one-minute intervals during the development and sampling of each well. The one-inch temporary monitoring wells will be sampled only during the first phase of sampling.

3.6 SURFACE WATER SAMPLING

To determine the surface water quality downgradient, adjacent to, and upgradient of the site, five surface water samples (including one to be collected directly from the storm sewer outfall pipe effluent that drains Locust Street and adjacent industrial facilities) will be collected

and analyzed for VOCs, SVOCs, and TAL metals, based on preliminary results of the first phase of sampling activities (Figure 2-1). Samples will be analyzed as detailed in Table 2-2. The farthest downstream sample will be collected first, working to the farthest upstream sample to minimize suspended sediments from upstream impacting the downstream samples. In addition, the storm sewer will be surveyed with a camera to determine if any areas of the pipe have been damaged. If, at the time of sampling, there are fluids discharging from any of the conduits along the riverbank, a surface water sample will be collected from the conduit.

3.7 SEDIMENT SAMPLING

To determine the stream sediment quality, five sediment samples will be collected from identical locations as the surface water samples and analyzed for VOCs, SVOCs and metals, based on preliminary results from the first phase of sampling (Figure 2-1). Samples will be analyzed as detailed in Table 2-2. Surface water samples will be collected prior to the collection of the sediment samples. In addition, the farthest downstream sample will be collected first, working to the farthest upstream sample to minimize suspended sediments from upstream impacting the downstream samples. If, at the time of sampling, there are fluids discharging from any of the conduits along the riverbank, a sediment sample will be collected from the conduit.

4.0 SAMPLING PROCEDURES

4.1 INTRODUCTION

This section outlines the sampling procedures to be used for the collection of soil, groundwater, surface water, and sediment samples at the CRS site. Appendix A of this document includes SOPs for collection of soil, groundwater, surface water, and sediment samples. Field measurements, equipment operation, and calibration procedures are included in Appendix B and C, respectively. Appendix D of this document includes various forms, which will be used to perform the various sampling activities.

4.1.1 Soil Boring Sampling

Soil borings will be advanced by direct-push technologies (e.g. Geoprobe^{TM}) in accordance with relevant Ohio guidance, as described in SOP 4, in Appendix A. Subsurface soil sampling will be completed at all borehole locations, as stated in Section 2. Soil sampling will be used to collect soil samples for laboratory analysis, geotechnical analysis, field description, and field screening. Surface soil samples collected along the top of the riverbank will be obtained using a stainless steel hand trowel.

4.1.2 Groundwater Sampling

Groundwater samples and field measurements will be collected as a part of this site investigation. Groundwater sampling and field measurement procedures will be performed in accordance with procedures outlined in SOP 7 (Appendix A).

4.1.3 Surface Water Sampling

Surface water samples will be obtained in a manner consistent with the objectives for the sampling program. Surface water sampling procedures will be performed in accordance with the procedures outline in SOP 13, in Appendix A.

4.1.4 Sediment Sampling

Surface water samples (Section 4.1.3) will be collected prior to the sediment samples to prevent suspended solids from being introduced into the surface water samples. Sediment samples will be collected following procedures outline in SOP 13 (Appendix A).

- The field geologist will log borehole geology and headspace measurements in the field book.

Soil Sampling Along Riverbank

- Surface soil samples collected from along the top of the riverbank will be obtained using a stainless steel hand trowel.
- Soil samples will be placed directly into the appropriate laboratory containers.
- In areas where there is sufficient soil cover, a soil sample will be collected for field screening for VOCs using a PID (SOP #12). In areas where there is not sufficient soil cover, a sample will not be collected for field screening.
- The hand trowel will be properly decontaminated (SOP #3) between each sample collection.

Soil Sampling

- The number and frequency of samples to be collected from each soil boring and the associated analytical parameters are presented in Section 2.
- Samples for VOC analyses (Method SW 846 5035) will be collected directly from the split spoon, and placed into three clean glass VOA laboratory grade jars and preserved with sodium bisulfate and methanol, according to method specifications.
- After VOCs samples are collected, soil samples to be analyzed for other analysis (SVOCs, PCBs, and metals) will be placed into clean laboratory supplied containers.